Remarks

This paper is in response to the Non-Final Office Action rejecting pending claims 1-19 over the prior art.

Amendments to the Claims

Claim 1 has been amended to recite a coated metal electrode wherein the coating does not result in a loss of the desired sensing characteristics of the electrode. Support for this amendment can be found in the specification, particularly on page 1, lines 25-28, as well on page 3, lines 14-18. Claims 18 and 19 have also been amended to further incorporate the limitations of claim 1. Claim 7 has been amended to correct a typographical error. No new matter has been added.

Claim Rejections under 35 USC § 102(b)

Claims 1, 2, 18, and 19 are rejected by the Examiner under 35 USC § 102(b)as being anticipated by French et. al., (Langmuir, 3-19, 1998, 2129-2133). Applicants respectfully disagree.

Amended claim 1, recites a coated metal electrode, the metal electrode comprising a coating and an overcoating, wherein the overcoating comprises a surfactant, wherein the coating comprises a sulfur containing moiety in its molecular structure. Additionally, the coating does not result in a loss of the desired sensing characteristics of the electrode, and results in a coated metal electrode whose temporal stability is greater than a temporal stability of a corresponding uncoated metal electrode.

The French reference pertains to the enhancement of the barrier properties of alkane-thiol coated gold electrodes using 1-octanol as a surfactant. The emphasis in French, is on preventing direct interaction between electrode and electro-active species in a solution, particularly at defect sites in a self assembled monolayer (SAM) of an alkanethiol. Additionally, French discloses that SAM's reduce the surface oxidation of the underlying gold electrode by preventing contaminants

and/or redox active solutes from depositing on the electrode. French further describes improving the barrier properties of the monolayer coated electrode by overlaying the monolayer with a coat of 1-octanol. According to French, 1-octanol forms an ultrathin film on top of the thiol monolayer and fills any defects in the self assembled monolayer, thus preventing the electro-active species from the solution from coming in direct contact with the electrode. Thus the thiol-octanol barrier on the electrode surface as taught by French *modifies the electrochemical behavior of the electrode by preventing direct electron flow to the electrode,* and requires the electrons involved in the electrochemical reaction to flow over longer distances (i.e., electron flow occurs across the applied barrier, since the electro-active species in solution is prevented from directly interacting with the electrode).

In the instant application the alkanethiol monolayer serves to function as a barrier that prevents unwanted hydrophobic contaminants from accumulating on the surface of the electrode. These contaminants would result in the formation of a layer that overcoats the alkanethiol monolayer, and would therefore impede or prevent an electro-active species from directly interacting with the surface of the metal electrode. Thus the function of the SAM-surfactant barrier in the instant application is to *prevent contaminants from altering the electrochemical behavior of the electrode.* The coated electrode therefore displays electrochemical/sensing characteristics similar to an uncoated metal electrode viz., the coated electrode does not restrict the direct flow of electrons (involved in the electrochemical reaction) between the redox species in solution and the electrode. Additionally, the surfactant overcoat improves the temporal stability of the coated electrode, while retaining the desirable electrochemical properties of the electrode. Thus, the thiol-surfactant layer of the instant application serves a different function as compared to that taught by French. Claim 1, as amended, requires that the coating does not result in the loss of desired sensing characteristics of the electrode. Thus, amended claim 1 contains allowable subject matter. Claims 2, 18 and 19 depend on claim 1 and are therefore allowable for at least all of the reasons mentioned for claim 1.

Claims 1, 2, 6, 7, 10, 11, 18, and 19 are rejected by the Examiner under 35 USC § 102(b)as being anticipated by Schweiss et. al., (CAPLUS abstract for Material Science Forum (1998), pp287-288). The Schweiss abstract pertains to the kinetics of adsorption/desorption of

various surfactants to/from the surface of a gold electrode coated with a self-assembled monolayer (SAM) of 1-octadecanethiol. Further, Schweiss discloses the influence of pH and ionic strength on the capacitance of a gold electrode coated with a monolayer of hydrophilic ω-terminated alkylthiols (e.g., 16-mercaptohexadecanoic acid and 20-mercaptoicosylamine). However, Schweiss does not teach the use of SAM's to prevent unwanted hydrophobic contaminants from adhering to the surface of the electrode nor does Schweiss teach a "coating" that would allow a metal electrode to display electrochemical properties similar to those displayed by an uncoated electrode, (i.e., allow direct interaction between the electro-active species and the electrode). In addition, Schweiss fails to disclose the use of a surfactant overcoat to improve the temporal stability of the coated electrode while also retaining the sensing characteristics of the coated electrode as taught by claim 1. Claim 1 is therefore patentable over Schweiss either alone or together with French. Claims 2, 6, 7, 10, 11, 18, and 19 are also patentable since they depend on a patentable base claim.

The Examiner also rejects claims 1, 2, 18, and 19 under 35 USC § 102(b)as being anticipated by Dong et. al., (Biochemistry and Bioenergetics, 42 (1997), pp7-13). The Examiner asserts that Dong discloses the use of a lipid as an overcoat on the alkanethiol coated electrode. Additionally, the Examiner asserts that the lipid overcoat reads on a surfactant and thus teaches the applicants claimed invention. Applicants respectfully disagree and state that claim 1, and the claims that depend from it are distinct over the prior art.

First, a lipid differs chemically from a surfactant and thus displays different physicochemical behavior as compared to a surfactant. Surfactants are polar compounds that are generally water loving, while lipids repel water. The surfactant overcoat in the instant application would therefore prevent the hydrophobic contaminants from accumulating and forming a barrier on the electrode while allowing charged electrolytes to come in contact with the electrode. Thus the surfactant overcoat of the present invention allows the redox species to directly interact with the electrode. Substituting the surfactant overcoat with a lipid layer as taught by Dong would alter the electrochemical behavior of the electrode. Contrary to the use of a surfactant overcoat, a lipid layer on the electrode of the invention would actually promote the deposition of hydrophobic contaminants onto the electrode surface. Furthermore, the lipid

overcoat would impede and / or restrict electrolytes in the solution from direct interaction with the electrode surface, thus altering the electrochemical behavior of the electrode. Furthermore, Section 3.3 of the Dong reference alluded to by the Examiner in the current Office Action, does not disclose the use of a lipid layer to improve the temporal stability of the coated electrode as taught by claim 1 of the instant application, nor does Dong disclose filling defects in the underlying self-assembled monolayer (made up of alkanethiol), with an overcoat of lipids. Thus Dong does not disclose the Applicants claimed invention.

Further, the examiner asserts that claim 18 pertaining to a method for coating a metal electrode and claim 19 that teaches a method for sensing an analyte using a coated electrode are unpatentable over Dong. Applicants respectfully disagree.

Claims 18 and 19 depend on amended claim 1 and have themselves been amended to include all the limitations of the base claim. Further, Dong teaches the use of a lipid instead of a surfactant for the overcoat. As discussed above lipids exhibit different physicochemical properties as compared to surfactants which would alter the electrochemical behavior of the electrode. Additionally, Dong teaches the incorporation monensin and/or valinomycin into the lipid coat for detecting monovalent ions (e.g., sodium and potassium) in a sample solution. The coated electrode of the instant application discloses the use of a surfactant as an overcoat, and furthermore, the instant application does not require the incorporation of either monensin or valinomycin into the surfactant layer.

Thus amended claim 1 is patentable over Dong and claims 2, 18 and 19 which depend on claim 1 are patentable for at least the same reasons mentioned for claim 1.

Claim Rejections under 35 USC § 103(a)

Claims 1-7, 10-13, 18, and 19 are rejected by the Examiner under 35 USC § 103(a) as being anticipated by Allen et. al, in view of French. The Allen reference discloses coating the surface of electrodes with different bifunctional organic compounds to assess their ability to promote direct electrochemistry of cytochrome-c at a gold electrode. However, as stated by the Examiner, Allen does not teach or even suggest the use of a surfactant overcoat, and the

Examiner relies on French to teach the use of such an overcoat. Applicants respectfully disagree and state that neither Allen nor French alone, or together, teach the Applicant's claimed invention.

The French reference discloses using a surfactant overcoat to fill in defects in the underlying alkanethiol monolayer to improve the barrier properties of coated metal electrodes. French thus emphasizes using a surfactant-thiol barrier to block non-specific electron flow to the electrode by preventing direct interaction between electro-active species in solution and electrode.

Allen teaches the use of surface modifiers and/or promoters to coat metal electrodes used for electrochemical studies with cytochrome-c. Although Allen makes no specific reference to using a surfactant to fill defects in the layer coating electrode surface, Allen does disclose the use of pre-activator molecules (e.g., 4,4'-dithiopyridine) to block (fill) "hot-spots" on the electrode surface prior to coating the electrode with surface modifiers (sulfur containing molecules). According to Allen the pre-activators help to orient the surface modifying groups in a favorable way to allow the surface modifying groups to interact transiently (via hydrogen bonding or electrostatic) with the side chains on residues of the protein involved in the electrochemical reaction. Overlaying the surface modifying layer of Allen with a surfactant such as 1-octanol as taught by French would disrupt or completely prevent the transient interactions between cytochrome-c in solution and the surface modifying groups, necessary for the proper electrochemical functioning of the coated electrode taught by Allen. Amended claim 1 of the instant application teaches modifying electrode surfaces using a coat of an alkanethiol and overcoating this thiol layer with a surfactant. Amended claim 1 further teaches that such a barrier *does not* alter the desired sensing characteristics or the temporal stability of the coated electrode in comparison to an uncoated electrode.

Thus, neither French nor Allen teach the Applicants claimed invention. The Examiner's attempt to combine the teachings of French with those of Allen to build the Applicants claimed invention is incorrect. Amended Claim 1 is therefore patentable over Allen in view of French.

Claims 2-7 and 10-12 depend on amended claim 1 and incorporate all of the limitations of claim 1. Claims 2-7 and 10-13, 18, and 19 are patentable for at least all the reasons mentioned for amended claim 1.

The Examiner also rejects claims 1, 2 and 6-19 under 35 USC § 103(a) as being anticipated by Schlereth et. al, in view of French. Schlereth teaches methods for preparing, and the use of cysteine and / or cystamine to coat a metal electrode surface. Schlereth further discloses the covalent immobilization of various redox mediators to the SAM's for studying electrochemical oxidation of NADH systems. However, Schlereth does not teach or suggest improving the temporal stability of the coated electrode and Schlereth additionally does not disclose retaining the desired sensing characteristics of an electrode coated with a sulfur containing moiety as required by amended claim 1. Thus the teachings of this reference are different from those of Claim 1 of the instant application.

Thus claim 1 is patentable over Schlereth. Claims 2 and 6-19 are also patentable, since they depend on an allowable base claim.

CONCLUSION

Applicants believe that the presently pending claims are in immediate condition for allowance and allowance is therefore respectfully requested. However, should any issues remain, the Examiner is urged to telephone the undersigned Attorney for Applicant in the event that such a communication is deemed to expedite allowance of this application.

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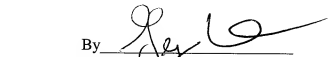
Respectfully submitted,



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